Laser Ranging (LR) Lunar Reconnaissance Orbiter (LRO) Data Flow and Scheduling

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Abstract

The Lunar Reconnaissance Orbiter (LRO), soon to be launched in early 2009, will present new challenges to the NASA and ILRS communities, by adding new requirements for scheduling, data format, and data flow. These new requirements are necessary to help ensure the success of the on-board Lunar Orbiter Laser Altimeter (LOLA) payload instrument. The NGSLR and other approved ILRS sites will conduct one-way ranging to the lunar-orbiting spacecraft to meet the intensive orbit determination requirements needed to develop a new lunar gravity field. NASA and HTSI have coordinated with the LR-LRO mission and LOLA payload experiment team to establish new processes to meet the new data operations and data requirements. This paper will detail the coordination efforts for all LR-LRO scheduling activities for the approved ILRS sites, the coordination of all LR-LRO fire data reception at the HTSI Data Operations Facility, and all LR-LRO data delivery to NASA's CDDIS and LOLA Science Operations Center (SOC).

Introduction

This paper describes the LR-LR data products, scheduling requirements, and the data transfer time tables and schematics.

LR-LRO Data Products

The LR-LRO data products will include predictions in the Consolidated Prediction Format (CPF), LR fire time data in the Consolidated Laser Ranging Data Format (CRD) or an internal Transponder Data Format (iTDF), and combined ground fire and spacecraft event normal points in the CRD.

GSFC Flight Dynamics Facility (FDF) will generate the predictions daily. The prediction files will be in the CPF and contain ten days of predictions. They will be delivered to, and accessed on, a secure location to the CDDIS. The predictions will be used to generate station visibilities, and station schedules, and used for real-time tracking. Stations using the predictions for real-time tracking should not apply any point-ahead corrections because the time of flight of to the satellite is accounted for when generating the predictions.

LR LRO fire-time data will be generated at the LR sites in the CRD or iTDF. The data will be delivered to the ILRS Data Operations Centers (HTSI,EDC). The data in the CRD should be named with an ".frf" extension to differentiate it from other types of

data in the CRD. Once at the HTSI Data Operations Facility, the fire data will be compiled together hourly, compressed with UNIX compression, and delivered to a secure location in the CDDIS. The LOLA Science Team will combine the ground fires with corresponding spacecraft events and generate normal points in the CRD.

The format details for CRD and CPF can be found on the ILRS web-site (Ricklefs 2006, Ricklefs 2008). Format details for the iTDF can be found on LRO-LR web-site. (McGarry, 2006)

ILRS LR-LRO Schedules

A combined Global LR-LRO schedule will be generated for all approved ILRS tracking stations. This schedule will contain suggested ranging opportunities for each tracking station. A station may not range to LRO outside the suggested opportunities. The schedules will generate every Friday for the following Monday – Sunday week and will be delivered to and may be accessed from a secure site on the CDDIS.

LRO predictions in the CPF will be used to the generate schedule. An initial set of station visibilities will be generated based on a 20 degree minimum tracking elevation, then portions of visibilities will be eliminated when LRO is behind the moon and when LRO is in with a sun angle restriction for a station. From these visibilities a global schedule will be generated based on station priorities and the High Gain Antenna schedule (WOTIS). If LRO is visible to two or more stations, then only the station with the highest priority will be scheduled. If the two or more stations have the same highest priority then all stations with that priority will be scheduled. The WOTIS may be used to determine if the LRO high gain antenna is pointed at S-Band system that is "near-by" to a LR station. Each LR station will have a corresponding set of S-Band systems that are determined to be "near-by". If a "near-by" S-Band system is not scheduled during an LR station's tracking opportunity then the station may not be scheduled. The WOTIS will be delivered from the LRO Mission Operations Center (MOC) to LRO SOC then stored in a secure site on the CDDIS.

Summary

The ILRS stations approved to range to LRO will generate fire data in the CRD or iTDF and send it to ILRS Data Operations Centers (HTSI, EDC). Combined global schedules will generated that include all approved ILRS stations. All LR_LRO products (predictions, fire data, normal points, and combined station schedules) will be hosted at a secure site on the CDDIS. The LR-LRO data flow schematic is displayed in Figure 1.

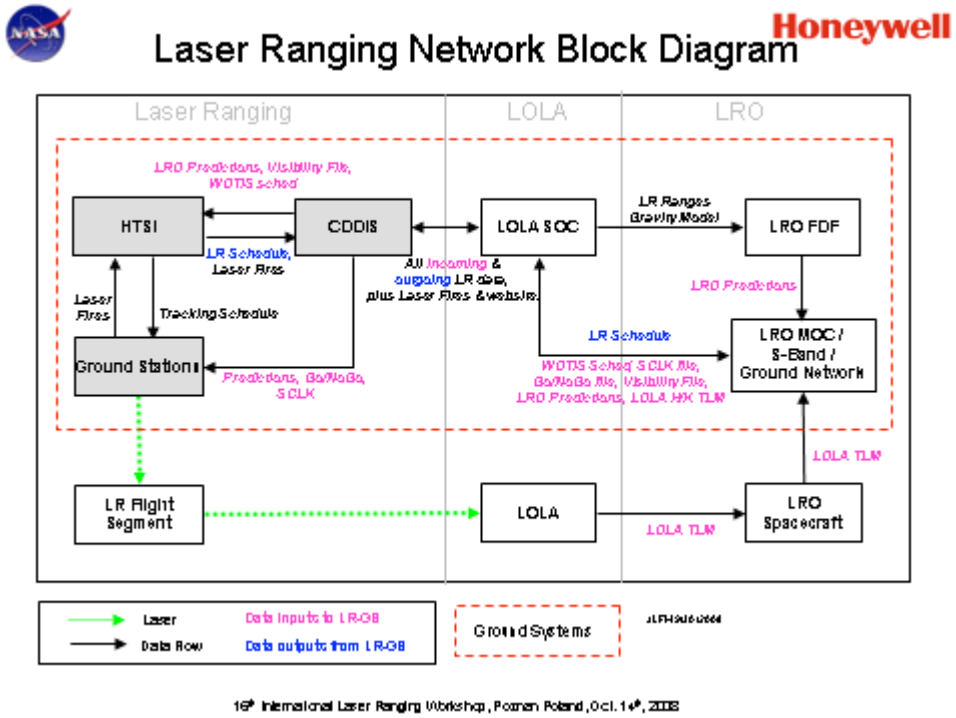

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Figure 1. LR-LRO Laser Ranging Network Diagram

References

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